



AFRL-SA-WP-SR-2017-0019

Motivation and Resolve of U.S. Air Force Pilot Candidates



**Rebecca Walsh, Lt Col Teg W. McBride, Jared T. Haynes,
Ryan P. Peirson**



June 2017

**DISTRIBUTION STATEMENT A. Approved
for public release. Distribution is unlimited.**

STINFO COPY

**Air Force Research Laboratory
711th Human Performance Wing
U.S. Air Force School of Aerospace Medicine
Aerospace Medicine Department
Aeromedical Consult Service
2510 Fifth St., Bldg. 840
Wright-Patterson AFB, OH 45433-7913**

NOTICE AND SIGNATURE PAGE

Using Government drawings, specifications, or other data included in this document for any purpose other than Government procurement does not in any way obligate the U.S. Government. The fact that the Government formulated or supplied the drawings, specifications, or other data does not license the holder or any other person or corporation or convey any rights or permission to manufacture, use, or sell any patented invention that may relate to them.

Qualified requestors may obtain copies of this report from the Defense Technical Information Center (DTIC) (<http://www.dtic.mil>).

AFRL-SA-WP-SR-2017-0019 HAS BEEN REVIEWED AND IS APPROVED FOR PUBLICATION IN ACCORDANCE WITH ASSIGNED DISTRIBUTION STATEMENT.

//SIGNATURE//

DR. DANIEL L. VAN SYOC
Deputy Chief, Aerospace Consult Service

//SIGNATURE//

COL CHARLES D. CLINTON
Chair, Aerospace Medicine Department

This report is published in the interest of scientific and technical information exchange, and its publication does not constitute the Government's approval or disapproval of its ideas or findings.

REPORT DOCUMENTATION PAGE				<i>Form Approved</i> <i>OMB No. 0704-0188</i>	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.					
1. REPORT DATE (DD-MM-YYYY) 15 Jun 2017		2. REPORT TYPE Special Report		3. DATES COVERED (From – To) May 2016 – August 2016	
4. TITLE AND SUBTITLE Motivation and Resolve of U.S. Air Force Pilot Candidates				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Rebecca Walsh, Lt Col Teg W. McBride, Jared T. Haynes, Ryan P. Peirson				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) USAF School of Aerospace Medicine Aerospace Medicine Dept Aeromedical Consult Service/FECN 2510 Fifth St., Bldg. 840 Wright-Patterson AFB, OH 45433-7913				8. PERFORMING ORGANIZATION REPORT NUMBER AFRL-SA-WP-SR-2017-0019	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSORING/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION / AVAILABILITY STATEMENT DISTRIBUTION STATEMENT A. Approved for public release. Distribution is unlimited.					
13. SUPPLEMENTARY NOTES Cleared, 88PA, Case # 2017-3515, 20 Jul 2017.					
14. ABSTRACT Prior to beginning U.S. Air Force pilot training, individuals complete neuropsychological testing to assess ability and stability of pilot candidates. Until recently, motivation and resolve have not been formally assessed during Medical Flight Screening. Pertinent research on motivation and resolve related to military aviation is reviewed. Novel measures of motivation and resolve were developed and administered to 720 U.S. Air Force pilot candidates, revealing higher intrinsic than extrinsic motivation to become pilots, as well as high amounts of resolve to pursue a military career in aviation. Those candidates slotted for manned versus unmanned aircrafts were compared, revealing similar amounts of motivation and resolve. However, manned aircraft pilot candidates were found to be slightly more intrinsically motivated and have slightly more resolve as it relates to their consistent diligence in their efforts to fly.					
15. SUBJECT TERMS Motivation, resolve, U.S. Air Force, pilots, neuropsychological testing, training, manned aircraft, unmanned aircraft					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT SAR	18. NUMBER OF PAGES 21	19a. NAME OF RESPONSIBLE PERSON Lt Col Teg McBride
a. REPORT U	b. ABSTRACT U	c. THIS PAGE U			19b. TELEPHONE NUMBER (include area code)

This page intentionally left blank.

TABLE OF CONTENTS

Section	Page
LIST OF TABLES	ii
1.0 SUMMARY	1
2.0 INTRODUCTION	1
3.0 BACKGROUND	1
3.1 Motivation	1
3.2 Measuring Motivation in Military Aviators	3
3.3 Grit	4
4.0 METHODS	6
4.1 Instruments	6
4.1.1 Motivation Survey (ACS Survey I)	6
4.1.2 Resolve Survey (ACS Survey II)	7
4.2 Statistical Analyses	8
5.0 RESULTS	8
5.1 Motivation Survey (Intrinsic – Extrinsic)	8
5.2 Resolve Survey	8
5.3 Manned vs. Unmanned Motivation and Resolve	9
6.0 DISCUSSION	12
7.0 REFERENCES	14
LIST OF ABBREVIATIONS AND ACRONYMS	15

LIST OF TABLES

	Page
Table 1. Motivation Survey (Intrinsic – Extrinsic) (N=720)	9
Table 2. Resolve Survey (N=720)	9
Table 3. Motivation Survey Training Assignment Descriptive Statistics.....	10
Table 4. Resolve Survey Training Assignment Descriptive Statistics	10
Table 5. Motivation Survey Comparison Statistics	11
Table 6. Resolve Survey Comparison Statistics	12

1.0 SUMMARY

Prior to beginning U.S. Air Force pilot training, individuals complete neuropsychological testing to assess ability and stability of pilot candidates. Until recently, motivation and resolve have not been formally assessed during Medical Flight Screening. Pertinent research on motivation and resolve related to military aviation is reviewed. Novel measures of motivation and resolve were developed and administered to 720 U.S. Air Force pilot candidates, revealing higher intrinsic than extrinsic motivation to become pilots, as well as high amounts of resolve to pursue a military career in aviation. Those candidates slotted for manned versus unmanned aircrafts were compared, revealing similar amounts of motivation and resolve. However, manned aircraft pilot candidates were found to be slightly more intrinsically motivated and have slightly more resolve as it relates to their consistent diligence in their efforts to fly.

2.0 INTRODUCTION

Prior to beginning U.S. Air Force (USAF) pilot training, all individuals must complete Medical Flight Screening (MFS) at either the USAF Academy in Colorado Springs, Colorado, or the USAF School of Aerospace Medicine in Dayton, Ohio. Neuropsychological screening (MFS-N) is one component of the process and serves two purposes. First, it provides baseline comparison data for clinical or fitness for duty decisions if an aviator experiences a future brain injury or mental illness. Second, it establishes normative psychological profiles for research.

For most military aviators, the lengthy pilot selection process begins long before they are actually considered for a “pilot slot.” They must pass through a series of filters that, in the end, strive to accurately assess an individual’s ability, stability, and motivation. In recent times, USAF pilots have been described as having the legendary “right stuff.” By and large, they have similarly exceptional intelligence and functional capacity (ability), demonstrated character and emotional composure (stability), and a consistent desire and proven resolve to become, and remain, a pilot (motivation). MFS-N consists of measures that objectively assess ability and stability of pilot candidates. However, other than an individual demonstrating a high level of motivation to fly by successfully completing the multiple steps to becoming a pilot (undergraduate college degree; Reserve Officers’ Training Corps, USAF Academy, or Officer Training School; and the multitude of administrative requirements), to date there is no objective measure of motivation used at MFS-N.

The goals of this research are to better understand what motivates pilot candidates to pursue aviation careers and to establish baseline motivation and grit scores. These scores can then be utilized, in conjunction with other MFS-N testing information, to understand pre-morbid functioning and to determine if aviators who have been removed from flying duties have returned to their best baseline functioning and meet waiver criteria to return to full aviation responsibilities.

3.0 BACKGROUND

3.1 Motivation

When a person is moved to act, we consider he or she motivated. The motivated individual feels energized and stimulated to behave. Conversely, when a person lacks inspiration

or energy to act, that person is considered unmotivated. Historically, motivation has been a difficult construct to measure because it is not a unitary concept. Motivation can vary in not only level, or how much motivation is involved in initiating a task, but can also vary in orientation [1]. Orientation of motivation refers to the underlying goals or reasons for action. Partitioned further, orientation of motivation consists of intrinsic and extrinsic factors that inspire an individual to act in specific goal-directed ways.

Intrinsic motivation can be defined as the motivation that drives individuals to act because they are genuinely interested in the behavior and find the action enjoyable [1]. The person engages in the activity because it is challenging and enjoyable, rather than doing it because there are external rewards, prompts, or pressures. Patall and colleagues found that individuals with higher intrinsic motivation levels participate more fully and are more likely to find the task pleasurable [2]. Intrinsic motivation also increases the likelihood that an individual will expend increased effort toward completing an undertaking. Additionally, intrinsic motivation has shown to contribute to longer persistence at a given task [2].

Intrinsic motivation is measured in two different ways. The first is through basic experimental research, in which investigators utilize the “free choice” measure. The experimenter has a participant engage in a task and informs the participant whether the activity will be associated with a reward or not. Following this, the experimenter tells the participant that he/she will no longer need to complete the task and leaves the participant alone in the room. At this point, the participant has a period of “free choice” about whether or not to return to the activity. The assumption is as follows: if no extrinsic reasons exist to act (e.g., no rewards), the longer the participant continues to engage in the activity the more intrinsically motivated he/she is to do the task. The second most common way intrinsic motivation is measured is by self-report surveys, which are designed to measure interest and enjoyment of specific tasks or activities [1].

Extrinsic motivation relates to the execution of an activity to attain a desired outcome. Often conceptualized as the opposite of intrinsic motivation, extrinsic motivation comes from influences outside of the individual and can be broken down into four distinct categories, each having different amounts of externality [1]. The classification that is closest to amotivation, or the state of motivation that lacks an intention to act, is called **external regulation**. This is the least autonomous form of extrinsic motivation. Typically, behaviors are carried out to be compliant, to meet an external demand, or to obtain a specific reward [3]. Examples of external regulation are “I fly because I get faster rank advancement” and “I get to wear a cool flight jacket.”

The second type of extrinsic motivation is **introjected regulation**. Involving the internalization of external influences, self-imposed pressures are employed to avoid guilt or to maintain self-esteem. An example of introjected regulation would be “I fly (or keep flying) because I want other people to think I am successful.”

A more autonomous form of extrinsic motivation is **identification**. This type of extrinsic motivation occurs when an individual consciously accepts a behavior as being important to achieve a personally valued outcome and willingly recognizes the behavior as his or her own. An example of identification is “I fly because it helps keep me well balanced in my life.”

Finally, the most autonomous form of extrinsic motivation is **integrated regulation**. This occurs when a person identifies the value of a behavior, internalizes it as congruent with one’s sense of self, and assimilates it as his or her own. An example of integrated regulation would be “I fly because I am a pilot; it is an essential part of who I am.” The more an individual

internalizes the reasons for an action or task, the more the extrinsically motivated actions become self-determined [4].

Simply put, performance is defined as the outcome of a motivated act [5]. The relationship between motivation and performance has been studied across a variety of domains, and it has long been assumed that intrinsic motivation is more predictive of action. In other words, if an individual enjoys a specific activity or task, he or she is more apt to engage in that action (and with more effort). Conversely, if an individual doesn't necessarily enjoy a task, and only feels external pressure to engage in it, he or she is less apt to take part in it.

3.2 Measuring Motivation in Military Aviators

Within organizational settings, studies have found that motivation for work-related behavior involves both environmental or external forces (e.g., rewards, promotions) and internal or inherent forces (e.g., enjoyment, fulfillment) [6]. As stated previously, individuals who are intrinsically motivated typically engage in task-driven behavior because they enjoy it. These intrinsically motivated individuals tend to look for opportunities to be challenged, to develop new skills, to master job-related tasks, and to enjoy their work [7]. Extrinsically motivated workers have been found to be less compliant and more often seek recognition, prestige, and opportunities for promotion compared to their intrinsically motivated colleagues [7].

To better understand how motivation levels affect performance, Frederick-Recascino and Hall investigated the relationship between student pilot motivation and performance during flight training. Student motivation was operationally defined by the number of times a student cancelled or no-showed flight lessons during pilot training (i.e., the fewer the number of cancelled or no-showed flights, the higher the motivation). Student performance was measured by the number of extra flight lessons combined with the number of written tests during training, where the fewer number of extra tests and lessons indicated higher performance overall. Results indicated that increasing levels of motivation (i.e., reduced number of cancellations and no-shows) led to increased performance (i.e., reduced number of extra flying lessons and written tests) during pilot training [5].

Marshburn researched whether Army aviators were more extrinsically or intrinsically motivated to gain flying experience. More specifically, he sought to determine whether intrinsic or extrinsic factors were more associated with aviators garnering higher levels of flying experience. For this study, flying experience was measured in the participant's total number of flight hours and total number of pilot-in-command flight hours. The study found that aviators who were more intrinsically motivated (flew for enjoyment, mastery, and challenge) obtained increased flying experience versus their more extrinsically motivated colleagues (flew for promotion, selection for command, or recognition) [6].

In an attempt to better predict overall performance during flight training, Forsman researched flight training performance and motivation. The aim was to determine if academic motivation would be predictive of flight training performance and indicate in advance the likelihood of students failing to complete the pilot training program at a Midwestern university [8]. Academic motivation was assessed by administering the Academic Motivation Scale [9], which measures the three major facets of motivation: amotivation, extrinsic motivation, and intrinsic motivation. Flight performance was measured by the number of hours a student required to complete 25 flight lessons combined with his/her overall flight performance ratings by instructors. Results indicated a positive correlation between both intrinsic and extrinsic

motivation scales and the number of hours it took to complete all 25 flight lessons. Forsman postulates that the results indicate that those who are more motivated take more time to learn all of the maneuvers and techniques taught. It was also theorized that individuals may take more time on each flying maneuver or technique to more fully grasp each aspect [8].

In another study investigating motivation to fly, Reddy and George examined two instances in which military aircrew members were evaluated for loss of motivation. In the first case, an Army helicopter pilot was disqualified due to sensorineural hearing loss and low motivation for flying. The pilot was cleared by medical for his hearing issues but then refused to return to flying due to a lack of support from his wife and family for his flying career, his anxiety associated with the death of one of his instructors in an aircraft incident, and his desire to join the infantry as he thought it would more efficiently further his military career. In the second case, a female Army helicopter pilot was initially pulled from flying status due to a back injury and diabetes. Once medically cleared, the pilot did not desire to return to flying for personal reasons that included a change in family priorities that she felt couldn't be supported in the aviation career field. In both cases, the aircrew members were removed from flying duties and it was assessed that the members' loss of motivation was in large part associated with their higher extrinsic motivation versus intrinsic motivation to fly. Also, it was highlighted that both had initially pursued aviation career fields for mostly extrinsic reasons [10].

3.3 Grit

In addition to motivation, a pilot candidate's level of grit is also an important facet of performance and success. Not only must one be motivated to fly, but a candidate must also have enough resolve or stick-to-itiveness to push through the adversity inherent in pilot training. When difficulties are encountered, grit is relied upon to persevere and push ahead. Grit has been found to be an excellent predictor of success in several high-stress and high-achievement career fields [11].

Duckworth and colleagues have defined grit as passion and determination for goals [12]. It consists of working diligently toward an objective and maintaining interest and work effort despite adversity or failure. Grit is a person's stamina toward achievement. Many factors have been found to influence grit, including education and age. Researchers have found that more educated adults have higher levels of grit compared to less educated adults of the same age. Controlling for education, it was found that grit increased with age, with older individuals usually having higher levels of grit than younger individuals [12].

In a study of U.S. Military Academy (West Point) cadets, Maddi et al. examined the relationship between grit and performance of cadets during training [13]. The cadets were administered a grit scale on the third day after arrival at West Point. The Short Grit Scale (Grit-S) was developed by Duckworth and Quinn to evaluate sustained pursuit of a given goal or interest [14]. The scale assessed the cadets' consistency of interests and perseverance of effort. Additionally, the researchers obtained the cadets' performance scores, which are the cumulative average of performance scores in different domains, including military and academic course work and fitness, and the Whole Candidate Score (WCS), which is a composite score consisting of high school academic performance, leadership potential, and physical fitness. Analysis found that all three variables (grit scale score, cadets' performance scores, and WCS) were positively correlated with retention; however, grit had the strongest overall relationship. The study highlighted grit as an important variable to consider when predicting performance outcomes.

In another study, Kelly, Matthews, and Bartone were interested in examining what factors are associated with a cadet's successful performance at West Point [15]. Historically, students are admitted to West Point based on academic performance and physical ability. The purpose of the investigation was to understand what non-cognitive and non-aptitude factors contribute to predict successful student performance. Historically, a cadet's successful performance at West Point has been forecast utilizing the WCS composite score mentioned above. This score, consisting of high school grade point averages, high school class rank, standardized test scores, leadership ability, and physical fitness scores, was calculated for each student. For this particular investigation, researchers were interested in what impact grit, a non-cognitive and non-aptitude factor, had on successful graduation of a 4-year undergraduate program at West Point. Grit was defined as an individual's "firmness of character" and is strongly associated with what West Point strives to build in its cadets. Previous studies found that grit was a stronger predictor of attrition from a summer training program as part of Cadet Basic Training than the WCS [12]. The West Point cadets were administered the 12-item Grit Scale to measure levels of grit [12]. The researchers found that cadets who had higher levels of grit and sustained effort were more likely to complete the challenging 47-month West Point program. Grit was found to be a significant and meaningful differentiator between cadets who completed Cadet Basic Training versus those who dropped out. Also, grit was found to be a significant differentiator between cadets who graduated from West Point and those who did not. Additionally, grit was positively correlated with overall performance and class ranking. Researchers concluded that non-cognitive factors such as grit are important to consider when attempting to appreciate why some individuals are successful in accomplishing longer term, challenging goals [15].

In a 2015 study, Lucas et al. defined grit as courage to persist toward a given goal through fear of failure [16]. In this study of grit and effort, the researchers evaluated participants playing a computer game. Grit was measured by having participants complete the 8-item Grit-S scale [14]. Effort was measured by how rapidly a participant could click his/her mouse versus an opponent. Lower grit individuals were found to have no problem persisting when the game seemed to be going in their favor, but when the favor turned toward their opponents, the less gritty participant's effort decreased significantly. The researchers also found that higher grit levels were associated with increased effort when losing and, when given the option to quit, grittier individuals would persist. The researchers concluded that grittier people tend to press on in the face of adversity when pursuing a goal, even when they are not achieving the level of success desired and have the option to cut their losses.

We have long held that exceptional intelligence and functional capacity (ability), demonstrated character and emotional composure (stability), and a consistent desire and proven resolve to become a pilot (motivation) are essential to Undergraduate Pilot Training (UPT) success. However, we postulate that a high level of resolve or grit (i.e., perseverance and effort despite adversity) is a needed characteristic of those who endure the rigors of UPT. We are unaware of any formal research investigating grit levels in pilots or pilot candidates.

The goals of the present project are to better understand what motivates a pilot candidate to pursue aviation as a career, as well as to establish baseline motivation and resolve or grit scores of pilot candidates. Baseline motivation and grit assessments can then be utilized, in conjunction with other MFS-N testing information, to better understand the characteristics of USAF pilot candidates. This personalized information can be useful for waiver consideration should the pilot be removed from flying duties at a future time.

4.0 METHODS

Before being cleared to begin UPT, pilot candidates must complete the in-depth MFS to determine whether they meet the established health and fitness requirements. MFS-N is part of the larger MFS process. MFS-N testing is completed on the first or second day of screening. Pilot candidates are tested as a group in the MFS-N computer lab. Typically, the groups range from 10 to 15 candidates. Depending on the day, testing is administered either in the morning at 8:00 a.m. or at noon. On average, testing takes about 3.5 hours to complete. Currently, MFS-N consists of three computer-based psychological testing measures to assess aspects of ability and stability of pilot candidates:

1. Multidimensional Aptitude Battery-II [17], an intelligence screening measure
2. MicroCog [18], a neuropsychological screening instrument assessing attention and concentration, reasoning, general memory, spatial analysis, as well as speed and accuracy of information processing
3. NEO-PI-3 [19], a Big Five personality measure

As mentioned above, MFS-N is used to establish a pilot candidate's baseline scores for future waiver consideration and research. Scores are not used for selection purposes, as all individuals completing MFS-N have been pre-selected and awarded a pilot "slot." Along with completing the three instruments of the MFS-N testing battery, 720 pilot candidates completed the motivation and resolve self-report surveys over a 7-month period in 2016; 92% were male and 8% were female. The average participant was 23 years old. The majority of pilot candidates at the time of evaluation were either assigned to manned aircraft pilot training or unmanned aircraft pilot training. Three hundred ninety-five endorsed manned and 272 endorsed unmanned; 53 were unaware of their assigned platforms at the time of assessment.

4.1 Instruments

The motivation and resolve surveys, developed by the Aeromedical Consult Service (ACS) and entitled "ACS Survey I" and "ACS Survey II," respectively, were completed at the end of the other MFS-N testing administrations. Both are paper and pencil self-report questionnaires. The order of the test items measuring extrinsic and intrinsic factors was randomized within the questionnaire, as were the items assessing resolve.

Regarding the motivation survey, the candidates were instructed to read each statement and indicate how well each describes them, on a 0- to 10-point Likert scale (0 being "strongly disagree" and 10 being "strongly agree"). On the resolve survey, candidates were similarly instructed to read each statement and select on a 0- to 10-point Likert scale (0 being "not like me at all" and 10 being "very much like me").

4.1.1 Motivation Survey (ACS Survey I). The 16-question survey comprises 7 intrinsic and 9 extrinsic statements, with a maximum possible score of 160.

Intrinsic Statements:

- Question 1: I have a desire to pursue a USAF pilot career even without the formal public recognition that distinguishes this career field.
- Question 6: I would continue to pursue a USAF pilot career even if career field incentives (e.g., flight pay, bonuses, status, etc.) were discontinued.
- Question 7: I have a sense of inner excitement toward starting training to become a USAF pilot.
- Question 9: Because of my desire to become a USAF pilot, I will experience disappointment if I fail training.
- Question 10: I selected a USAF pilot career field because supporting battlefield and humanitarian operations is personally rewarding.
- Question 12: I have a desire to be a USAF pilot despite economic incentives (e.g., flight pay, hazardous duty pay, commissioning bonus, future employability).
- Question 14: I have a desire to serve in a high-risk/high-demand job supporting battlefield and humanitarian operations.

Extrinsic Statements:

- Question 2: My decision to pursue a USAF pilot career field was influenced by my desire to uphold family tradition.
- Question 3: The primary reason I selected a USAF pilot career field was to avoid an untimely delay in entering the Air Force.
- Question 4: I chose a USAF pilot career field over other officer career fields because of the increased benefits for USAF pilots (e.g., commissioning bonus, flight pay, future employability).
- Question 5: My decision to pursue a USAF pilot career field is influenced by the positive recognition I will receive from others.
- Question 8: It is the responsibility of USAF leadership (training instructors, supervisors, commanders) to ensure I succeed as a USAF pilot through individually tailored achievement programs.
- Question 11: The unique badges and flight suits that USAF pilots wear attract me to the career field.
- Question 13: A large part of my desire to become a USAF pilot is to demonstrate to others that I am “a cut above the rest.”
- Question 15: My decision to become a USAF pilot was largely influenced by media (e.g., movies, TV, video games).
- Question 16: My decision to pursue a USAF pilot career field was influenced by the encouragement from others (i.e., family, friends, coaches, and teachers).

4.1.2 Resolve Survey (ACS Survey II). The 11-question survey comprises 4 positive and 7 negative response biased statements, with a maximum possible score of 110.

Positive Response Biased Statements:

- Question 4: I have achieved many goals that took years of work.
- Question 7: I am a hard worker.
- Question 8: I finish whatever I begin.
- Question 11: I am diligent regarding my efforts to fly.

Negative Response Biased Statements:

- Question 1: I have difficulty maintaining my focus on projects that take more than a few months to complete.
- Question 2: I have been obsessed with a certain idea or project for a short time but later lost interest.
- Question 3: New ideas and projects sometimes distract me from previous ones.
- Question 5: I often set a goal but later choose to pursue a different one.
- Question 6: I become interested in new pursuits every few months.
- Question 9: My interest in flying changes from year to year.
- Question 10: Setbacks discourage me from becoming a USAF pilot.

4.2 Statistical Analyses

Descriptive statistics of mean, standard deviation, median, mode, range of responses (potential and actual), and a 5-point percentile table were used to describe the data sets.

5.0 RESULTS

5.1 Motivation Survey (Intrinsic – Extrinsic)

The survey total score distribution was symmetric of the mean score (94.2) with a standard deviation (SD) of 15.4 and the median score was relatively close (94). All of the intrinsic question responses had a mode score of 10 with an average item score of 8.6. A majority of the extrinsic questions responses had a mode score of 0, with the exception of questions 8, 11, and 16, and an overall average item score of 3.6 (Table 1).

5.2 Resolve Survey

The negative response biased questions (items 1, 2, 3, 5, 6, 9, 10) were inversely scored. For example, question 9: “My interest in flying changes from year to year.” If the pilot candidate endorsed a 0 (not like me at all), it was scored as a 10. This resulted in a higher total score equaling higher overall resolve. All of the question responses had an actual score range of 10, with the exception of positive biased questions 7 and 8 (7: 4-10, 8: 3-10). Median and percentile score statistics accurately describe the distribution of survey responses, as the distribution of the scores was not symmetric about the mean. The resolve survey total score distribution was symmetric about the mean score (84.6) and the median score was relatively close (84) (Table 2).

Table 1. Motivation Survey (Intrinsic – Extrinsic) (N=720)

Question	Type of Question	Mean	SD	Median	Mode	Range		Percentile (%)				
						Potential	Actual	5 th	25 th	50 th	75 th	95 th
1	Intrinsic	9.2	1.4	10	10	0-10	0-10	7	9	10	10	10
2	Extrinsic	3.3	3.3	2	0	0-10	0-10	0	0	2	6	10
3	Extrinsic	0.9	1.8	0	0	0-10	0-10	0	0	0	1	5
4	Extrinsic	3.8	3.2	3	0	0-10	0-10	0	0	3	6	10
5	Extrinsic	3.5	2.7	3	0	0-10	0-10	0	1	3	6	8
6	Intrinsic	8.0	2.3	9	10	0-10	0-10	3	7	9	10	10
7	Intrinsic	9.4	1.2	10	10	0-10	0-10	7	9	10	10	10
8	Extrinsic	4.4	2.6	5	5	0-10	0-10	0	3	5	6	9
9	Intrinsic	8.6	1.8	9	10	0-10	0-10	5	8	9	10	10
10	Intrinsic	8.4	1.9	9	10	0-10	0-10	5	7	9	10	10
11	Extrinsic	4.6	2.9	5	5	0-10	0-10	0	2	5	7	10
12	Intrinsic	8.3	2.1	9	10	0-10	0-10	5	7	9	10	10
13	Extrinsic	5.0	3.1	5	0	0-10	0-10	0	2	5	7	10
14	Intrinsic	8.5	1.7	9	10	0-10	0-10	5	7	9	10	10
15	Extrinsic	2.6	2.5	2	0	0-10	0-10	0	0	2	4	7
16	Extrinsic	5.8	3.0	6	7	0-10	0-10	0	3	6	8	10
Intrinsic Total		60.4	7.5	62	70	0-70	30-70	46	56	62	67	70
Extrinsic Total		33.8	13.9	34	37	0-90	0-74	11	24	34	43	57
Intrinsic – Extrinsic Total		94.2	15.4	94	90	0-160	30-144	70	84	94	104	120

Table 2. Resolve Survey (N=720)

Question	Mean	SD	Median	Mode	Range		Percentile (%)				
					Potential	Actual	5 th	25 th	50 th	75 th	95 th
1	7.8	2.0	8	10	0-10	0-10	4		8	10	10
2	6.7	2.3	7	8	0-10	0-10	3	5	7	8	10
3	5.7	2.3	5	4	0-10	0-10	3	4	5	7	10
4	8.4	1.6	8	10	0-10	0-10	6	7	8	10	10
5	6.7	2.1	7	8	0-10	0-10	3	5	7	8	10
6	6.1	2.2	6	7	0-10	0-10	3	4	6	8	10
7	9.1	1.1	9	10	0-10	4-10	7	8	9	10	10
8	8.4	1.4	9	10	0-10	3-10	6	7	9	10	10
9	8.5	2.0	9	10	0-10	0-10	5	8	9	10	10
10	8.4	1.9	9	10	0-10	0-10	5	7	9	10	10
11	8.9	1.4	9	10	0-10	0-10	6	8	9	10	10
Total	84.6	12.7	84	80	0-110	35-110	63	76	84	94	105

5.3 Manned vs. Unmanned Motivation and Resolve

Manned versus unmanned comparisons on both the motivation and resolve surveys were done using the Wilcoxon two-sample test as distributions were not symmetric about the mean. Tables 3 and 4 show descriptive statistics and Tables 5 and 6 provide comparison statistics for the motivation and resolve surveys. Multiple items from both the motivation and resolve surveys were found to be significant at the 0.05 level, with respective small effect sizes. These will be elucidated below.

Table 3. Motivation Survey Training Assignment Descriptive Statistics

Question	Manned Aircraft (N=395)									Unmanned Aircraft (N=272)								
	Mean (SD)	Min	Max	Percentile (%)					Mean (SD)	Min	Max	Percentile (%)						
				5 th	25 th	50 th	75 th	95 th				5 th	25 th	50 th	75 th	95 th		
1 Intrinsic	9.38 (1.21)	0	10	7	9	10	10	10	8.99 (1.51)	0	10	6	8	10	10	10		
2 Extrinsic	3.33 (3.31)	0	10	0	0	2	6	10	3.28 (3.35)	0	10	0	0	2	6	10		
3 Extrinsic	0.72 (1.63)	0	10	0	0	0	0	4	1.10 (2.06)	0	10	0	0	0	2	5		
4 Extrinsic	3.58 (3.10)	0	10	0	0	3	6	9	4.11 (3.26)	0	10	0	0.5	5	7	10		
5 Extrinsic	3.55 (2.74)	0	10	0	1	3	6	8	3.50 (2.75)	0	10	0	1	3	6	8		
6 Intrinsic	8.28 (2.20)	0	10	4	7	9	10	10	7.50 (2.42)	0	10	3	6	8	10	10		
7 Intrinsic	9.66 (0.81)	5	10	8	10	10	10	10	9.01 (1.46)	0	10	6	8	10	10	10		
8 Extrinsic	4.36 (2.49)	0	10	0	3	5	6	9	4.39 (2.82)	0	10	0	2	4	6	10		
9 Intrinsic	8.86 (1.61)	1	10	6	8	10	10	10	8.35 (1.93)	0	10	5	7	9	10	10		
10 Intrinsic	8.54 (1.68)	2	10	5	7	9	10	10	8.35 (2.01)	0	10	5	7	9	10	10		
11 Extrinsic	4.67 (2.89)	0	10	0	2	5	7	10	4.58 (2.86)	0	10	0	2	5	7	10		
12 Intrinsic	8.70 (1.82)	0	10	5	8	10	10	10	7.80 (2.23)	0	10	4	7	8	10	10		
13 Extrinsic	5.01 (3.09)	0	10	0	2	5	7	10	5.06 (3.06)	0	10	0	2	5	7.5	10		
14 Intrinsic	8.64 (1.58)	0	10	6	8	9	10	10	8.24 (1.90)	0	10	5	7	9	10	10		
15 Extrinsic	2.62 (2.40)	0	10	0	0	2	4	7	2.54 (2.52)	0	10	0	0	2	4	7		
16 Extrinsic	5.76 (3.00)	0	10	0	3	6	8	10	5.79 (3.02)	0	10	0	4	6	8	10		
Intrinsic Total	62.06 (6.50)	40	70	50	58	63	67	70	58.23 (8.56)	30	70	42	53	59.5	65	70		
Extrinsic Total	33.60 (13.70)	0	74	12	24	33	42	59	34.34 (14.04)	0	70	12	24.5	35	44	57		
Overall Total	95.66 (14.41)	63	144	74	86	94	104	121	92.57 (16.68)	30	138	65	81	93	103	118		

Table 4. Resolve Survey Training Assignment Descriptive Statistics

Question (Response Bias)	Manned Aircraft (N=395)									Unmanned Aircraft (N=272)								
	Mean (SD)	Min	Max	Percentile (%)					Mean (SD)	Min	Max	Percentile (%)						
				5 th	25 th	50 th	75 th	95 th				5 th	25 th	50 th	75 th	95 th		
1 (-)	7.89 (1.92)	1	10	4	7	8	10	10	7.77 (1.99)	0	10	4	7	8	10	10		
2 (-)	6.75 (2.26)	1	10	3	5	7	8	10	6.73 (2.25)	0	10	3	5	7	8	10		
3 (-)	5.84 (2.29)	0	10	3	4	6	8	10	5.63 (2.25)	0	10	2	4	5	7	10		
4 (+)	8.56 (1.40)	3	10	6	8	9	10	10	8.21 (1.79)	0	10	5	7	8	10	10		
5 (-)	7.05 (1.96)	0	10	3	6	7	8	10	6.35 (2.28)	0	10	2	5	6	8	10		
6 (-)	6.22 (2.21)	0	10	3	5	6	8	10	5.85 (2.21)	0	10	2	4	6	7	10		
7 (+)	9.11 (1.02)	5	10	7	8	9	10	10	8.98 (1.12)	4	10	7	8	9	10	10		
8 (+)	8.49 (1.44)	3	10	6	8	9	10	10	8.33 (1.43)	3	10	6	7	8	10	10		
9 (-)	8.81 (1.74)	1	10	6	8	10	10	10	7.97 (2.20)	0	10	3	7	8	10	10		
10 (-)	8.60 (1.74)	0	10	5	8	9	10	10	8.18 (1.97)	2	10	4	7	9	10	10		
11 (+)	9.23 (1.14)	4	10	7	9	10	10	10	8.49 (1.61)	0	10	5	8	9	10	10		
Total	86.56 (12.09)	52	110	67	78	86	96	106	82.48 (13.23)	35	110	61	73	82	93	105		

Table 5. Motivation Survey Comparison Statistics

Question	Manned Aircraft (N=395)		Unmanned Aircraft (N=272)		Wilcoxon Two-Sample Test Z Statistic	p-Value	Effect Size r
	Median	Range	Median	Range			
1 Intrinsic	10	10	10	10	-4.1618	<0.0001 ^a	0.1611 ^b
2 Extrinsic	2	10	2	10	-0.3033	0.7617	0.0117
3 Extrinsic	0	10	0	10	2.7347	0.0062 ^c	0.1059 ^b
4 Extrinsic	3	10	5	10	2.0083	0.0446 ^d	0.0778
5 Extrinsic	3	10	3	10	-0.3534	0.7238	0.0137
6 Intrinsic	9	10	8	10	-4.6876	<0.0001 ^a	0.1815 ^b
7 Intrinsic	10	5	10	10	-7.0958	<0.0001 ^a	0.2748 ^b
8 Extrinsic	5	10	4	10	-0.1537	0.8779	0.0060
9 Intrinsic	10	9	9	10	-3.7997	0.0001 ^a	0.1471 ^b
10 Intrinsic	9	8	9	10	-0.7608	0.4468	0.0295
11 Extrinsic	5	10	5	10	-0.4818	0.6300	0.0187
12 Intrinsic	10	10	8	10	-6.0005	<0.0001 ^a	0.2323 ^b
13 Extrinsic	5	10	5	10	0.1309	0.8958	0.0051
14 Intrinsic	9	10	9	10	-2.4904	0.0128 ^d	0.0964
15 Extrinsic	2	10	2	10	-0.7166	0.4736	0.0277
16 Extrinsic	6	10	6	10	0.1449	0.8848	0.0056
Intrinsic Total	63	30	59.5	40	-5.7123	<0.0001 ^a	0.2212 ^b
Extrinsic Total	33	74	35	70	0.9661	0.3340	0.0374
Overall Total	94	81	93	108	-2.0553	0.0399 ^d	0.0796

^ap<0.001.

^bSmall effect size r>0.1.

^cp<0.01.

^dp<0.05.

Table 6. Resolve Survey Comparison Statistics

Question	Manned Aircraft (N=395)		Unmanned Aircraft (N=272)		Wilcoxon Two- Sample Test Z Statistic	p-Value	Effect Size r
	Median	Range	Median	Range			
1	8	9	8	10	-0.7104	0.4774	0.0275
2	7	9	7	10	-0.1061	0.9155	0.0041
3	6	10	5	10	-1.0815	0.2795	0.0419
4	9	7	8	10	-2.0758	0.0379 ^a	0.0804
5	7	10	6	10	-3.8620	0.0001 ^b	0.1495 ^c
6	6	10	6	10	-2.0914	0.0365 ^a	0.0810
7	9	5	9	6	-1.3514	0.1766	0.0523
8	9	7	8	7	-1.5989	0.1098	0.0619
9	10	9	8	10	-5.3795	<0.0001 ^b	0.2083 ^c
10	9	10	9	8	-2.7869	0.0053 ^d	0.1079 ^c
11	10	6	9	10	-6.5931	<0.0001 ^b	0.2553 ^c
Total	86	58	82	75	-3.6690	0.0002 ^b	0.1421 ^c

^ap<0.05.^bp<0.001.^cSmall effect size r>0.1.^dp<0.01.

6.0 DISCUSSION

The primary inference from the results of both the motivation and resolve surveys is consistent with both the requirements for selection and previous observations of USAF pilot candidates: they appear highly motivated with high determination and resolve. It is not surprising that USAF pilot candidates have been described by those in the aeromedical community as “supernormal” individuals. As made evident by the average item scores (the average intrinsic item score is 8.6 with a mode of 10 and the average extrinsic item score is 3.6 with a mode of 0), pilot candidates appear much more intrinsically than extrinsically motivated. This leads one to conclude that the average USAF pilot candidate is primarily seeking an aviation career field out of interest, desire, and inner excitement. This supports a notion generally held by those who evaluate candidates in the MFS program: typical pilot candidates have been excited to fly since they were children. However, they are not homogenous. There is a wide range of total scores on both surveys: motivation – low of 30 to high of 144; resolve – low of 35 to high of 110.

The highest intrinsic item is question 7 (I have a sense of inner excitement toward starting training to become a USAF pilot), with an average item score of 9.4. The second highest intrinsic item is question 1 (I have a desire to pursue a USAF pilot career even without the formal public recognition that distinguishes this career field), with an average item score of 9.2. The lowest intrinsic item is question 6 (I would continue to pursue a USAF pilot career even if career field incentives [e.g., flight pay, bonuses, status, etc.] were discontinued), with an average score of 8.0. This is higher than the highest extrinsic item, question 16 (My decision to pursue a USAF pilot career field was influenced by the encouragement from others [i.e., family, friends,

coaches, and teachers]), with an average score of 5.8. The lowest two extrinsic items are question 3 (The primary reason I selected a USAF pilot career field was to avoid an untimely delay in entering the Air Force) and question 15 (My decision to become a USAF pilot was largely influence by media [e.g., movies, TV, video games]), with average item scores of 0.9 and 2.6, respectively. This indicates that pilot candidates did not select the pilot career field out of convenience (i.e., they would have preferred another career field but did not want to postpone their USAF career) and they were minimally influenced by the media in their pursuits to become pilots.

The highest positively biased resolve items are question 7 (I am a hard worker), with an average score of 9.1, and question 11 (I am diligent regarding my efforts to fly), with an average score of 8.4. The highest negatively biased resolve items are question 9 (My interest in flying changes from year to year), with an average score of 8.5, and question 10 (Setbacks discourage me from becoming a USAF pilot), with an average score of 8.4. This indicates that pilot candidates feel they have diligently toiled in their pursuits to become USAF pilots. The lowest resolve items are question 3 (New ideas and projects sometimes distract me from previous ones), with an average score of 5.7, and question 6 (I become interested in new pursuits every few months), with an average score of 6.1. This indicates that pilot candidates, consistent with many other young adults, have evolving interests as they experience life with more independence.

Pilot candidates assigned to fly manned aircraft versus pilot candidates assigned to fly unmanned aircraft have very similar resolve scores. Manned aircraft pilot candidates are slightly more intrinsically motivated than unmanned aircraft pilot candidates (63 vs. 59.5, $p < 0.0001$, with small effect size, $r = 0.02212$). Question 7 (I have a sense of inner excitement toward starting training to become a USAF pilot) has the largest effect size of the two groups ($r = 0.2748$), but is still considered small. This appears mostly associated with the larger range of responses from the unmanned aircraft pilot candidates (manned range 5, unmanned range 10). This indicates that fewer unmanned aircraft pilot candidates are as excited to begin training compared to manned pilot candidates. Also, manned pilot candidates have slightly more resolve than unmanned pilot candidates (86 vs. 82, $p < 0.0002$, with small effect size, $r = 0.1421$). The most significant resolve differences are all related to items associated with flying: My interest in flying changes from year to year (question 9), Setbacks discourage me from becoming a USAF pilot (question 10), and I am diligent regarding my efforts to fly (question 11). This indicates that manned aircraft pilot candidates have been more consistently diligent in their efforts to fly, albeit only somewhat.

Future directions of this research include establishing baseline motivation and resolve scores of trained aviators. This will allow a comparison of experienced aviators' scores to those being evaluated at the ACS to assist in determining whether an individual is fit to return to full aviation duties. Also, we plan to collect and compare pilot candidates' performance in UPT to their motivation and resolve scores. As we theorize that high resolve may help compensate for an individual's lack of natural abilities, this analysis will provide insight into the impact of motivation and resolve on pilot training outcomes.

7.0 REFERENCES

1. Ryan RM, Deci EL. Intrinsic and extrinsic motivations: classic definitions and new directions. *Contemp Educ Psychol*. 2000; 25(1):54-67.
2. Patall EA, Cooper H, Robinson JC. The effects of choice on intrinsic motivation and related outcomes: a meta-analysis of research findings. *Psychol Bull*. 2008; 134(2):270-300.
3. Tremblay MA, Blanchard CM, Taylor S, Pelletier LG, Villeneuve, M. Work extrinsic and intrinsic motivation scale: its value for organizational psychology research. *Can J Behav Sci*. 2009; 41(4):213-226.
4. Ünlü A, Dettweiler U. Motivation internalization and simplex structure in self-determination theory. *Psychol Rep*. 2015; 117(3):675-691.
5. Frederick-Recascino CM, Hall S. Pilot motivation and performance: theoretical and empirical relationships. *Int J Aviat Psychol*. 2003; 13(4):401-414.
6. Marshburn TH. Why they fly: an expectancy-based analysis of the factors that motivate commissioned Army aviators to gain flying experience [Master's thesis]. Fort Leavenworth (KS): U.S. Army Command and General Staff College; 2007.
7. Amabile TM, Hill KG, Hennessey BA, Tighe EM. The Work Preference Inventory: assessing intrinsic and extrinsic motivational orientations. *J Pers Soc Psychol*. 1994; 66(5):950-967.
8. Forsman JW. The creation and validation of a pilot selection system for a Midwestern university aviation department [Master's thesis]. Mankato (MN): Minnesota State University; 2012.
9. Vallerand RJ, Pelletier LG, Blais MR, Briere NM, Senecal C, Vallieres EF. The academic motivation scale: a measure of intrinsic, extrinsic, and amotivation in education. *Educ Psychol Meas*. 1992; 52(4):1003-1017.
10. Reddy NS, George CS. Loss of motivation to fly in military aircrew (two case studies). *Indian Journal of Aerospace Medicine*. 2014; 58(1):15-20.
11. Burkhart RA, Tholey RM, Guinto D, Yeo CJ, Chojnacki KA. Grit: a marker of residents at risk for attrition? *Surgery*. 2014; 155(6):1014-1022.
12. Duckworth AL, Peterson C, Matthews MD, Kelly DR. Grit: perseverance and passion for long-term goals. *J Pers Soc Psychol*. 2007; 92(6):1087-1101.
13. Maddi SR, Matthews MD, Kelly DR, Villareal B, White M. The role of hardiness and grit in predicting performance and retention of USMA cadets. *Mil Psychol*. 2012; 24(1):19-28.
14. Duckworth AL, Quinn PD. Development and validation of the Short Grit Scale (Grit-S). *J Pers Assess*. 2009; 91(2):166-174.
15. Kelly DR, Matthews MD, Bartone PT. Grit and hardiness as predictors of performance among West Point cadets. *Mil Psychol*. 2014; 26(4):327-342.
16. Lucas GM, Gratch J, Cheng L, Marsella S. When the going gets tough: grit predicts costly perseverance. *J Res Pers*. 2015; 59:15-22.
17. Jackson DN. Multidimensional Aptitude Battery-II: manual. Port Huron (MI): SIGMA Assessment Systems; 1998.
18. Powell D, Kaplan E, Whitla D, Weintraub S, Catlin R, Funkenstein H. MicroCog: manual. San Antonio (TX): PsychCorp; 1993.
19. Costa PT, McCrae RR. NEO-PI-3: manual. Port Huron (MI): SIGMA Assessment Systems; 2010.

LIST OF ABBREVIATIONS AND ACRONYMS

ACS	Aeromedical Consult Service
MFS	Medical Flight Screening
MFS-N	Neuropsychological Medical Flight Screening
SD	Standard Deviation
UPT	Undergraduate Pilot Training
USAF	U.S. Air Force
WCS	Whole Candidate Score